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glorious plenitude of Helmholtz's work in but a single department. We read here of his philosophical discussions relative to the foundations of mathematics, which opposed the modern empirical view to the transcendentalism of Kant; of his physiological and psychological researches which furnished the foundations of his subsequent empirical theory of the origin of space and time; of his researches in the non-Euclidean geometry proper; of his application of the latter to colors; of his enunciation of the principle of the conservation of work; of his hydrodynamical and aerodynamical investigations; of his theory of vortices; of his researches in electricity; of his consequent examination of the fundamental principles of mechanics and the theorems resulting therefrom; and finally of his theories regarding the dynamic constitution of matter, the ether, etc. This last was the final work of his life, and we learn that the intended subject of his address at the meeting of the German physicians and inquirers in Vienna was actually "Permanent Forms of Motion and Apparent Substances." What the character of this address would have been is unknown, as only a few notes regarding it were found among Helmholtz's literary remains, but it is supposed that it would have elaborated the philosophical foundation of the extensive researches which he had been conducting in his last years regarding the basic principles of mechanics and physics and at which he had hinted in his Introduction to the *Mechanics* of Hertz. Of his achievements in this department, let us finally add, the reader will find in this pamphlet of Dr. Koenigsberger a concise and worthy account. A fine portrait of Helmholtz taken from the oil painting in the possession of Frau Ellen von Siemens, forms the frontispiece of the brochure. THOMAS J. MCCORMACK.

DIE UEBERWINDUNG DES WISSENSCHAFTLICHEN MATERIALISMUS. By *Wilhelm Ostwald*, Professor der Chemie an der Universität Leipzig. Leipsic: Veit & Comp. 1895. Pages, 36.

This pamphlet of thirty-six pages is a lecture which Prof. Wilhelm Ostwald, one of the most prominent chemists of Germany, and Professor at the University of Leipsic, delivered on September 20, 1895, before the Association of German Naturalists and Physicians at Lübeck. It is a protest against the materialism of science, and the author is fully aware that he has taken a position at variance with the opinions of many great scientists. He has the consciousness of a lookout whose duty it is to call "breakers ahead!"

The famous *Ignorabimus* of Du Bois-Reymond is in Professor Ostwald's opinion nothing but a protest against the mechanistic world-conception which is at present dominant in scientific circles. Ostwald does not seriously believe in the *Ignorabimus*, but claims that we have not as yet fully understood the salient point of the problem, for there are processes which are not representable by mechanistic equations, and this much is certain that we must give up the hope of interpreting the world as a mere play of atoms. Professor Ostwald proposes to replace mechanism by the energetic world-conception. The result of his investigation remains at present negative. He calls attention to the fact that the pressure of gases is equal in all directions. The factors of electric energy, potential, and electrical quantities generally, such magnitudes as may be called polar, being representable not only by numbers but also by opposite signs which, when added, reduce two equal quantities to zero, are not known in mechanics, and this Professor Ostwald declares is the reason why we are unable to find a mechanical hypothesis for electrical phenomena. By reducing the laws of nature to analogous modes of an energy, the author hopes to attain to a science that would be free from hypothesis. Professor Ostwald finds a substratum of energy redundant, and believes that energy should, with the exception of time and space, be the sole magnitude for scientific equations. He does not enter into a discussion of the details of his world-conception, but considering that energy is expressed either in motion or in the possibility of motion, his philosophy is more mechanistic than his censure of the mechanistic world-conception seems to allow.

He concludes his lecture with the question: Is energy, indispensable and useful as it is for the comprehension of natüre, indeed sufficient for this purpose, or are there phenomena which cannot be formulated in the hitherto known laws of energy? This question is briefly answered in the negative, and we may expect that Professor Ostwald will present his arguments on this head in future investigations. But we wish to state at once that the conception of energy is as little all-sufficient for the interpretation and explanation of nature, as are the conceptions matter or spirit. For there are phenomena in nature which cannot be reduced to energy. We ought to remember that energy, matter, space, and spatial relations, sentiency, including all subjective phenomena of soul-life, ideas, and all representative psychical images of mental life are different fields of abstraction. None of our generalisations will be found sufficient to serve as an all-comprehensive idea under which all phenomena can be subsumed. Monism should not become a single-substance theory. The principle of genuine monism is preserved when we bear in mind that the totality of nature is one indiscerptible entirety, and that our various conceptions are aspects of different features of reality. Professor Ostwald will find it impossible to explain the nature of ideas from any kind of energy, for ideas have nothing to do with energy. What has the notion of a mathematical line or circle to do with either pressure or motion, or with any mode of motion, be it electricity, light, or what not?

Professor Ostwald's lecture has created quite a stir in the scientific world, and it appears that he has been greatly misunderstood. He has been suspected of a hankering after unscientific notions of mystic and agnostic world-conceptions, but from the trend of the lecture it seems to us quite clear that the tendency of his thought is exactly the opposite. He wants to realise the ideal of a genuine positivism in which science would be a mere description of facts free from all hypothesis. Though the lecture does not propose a definite solution of the problem, and gives only a hint which in our conception does not lead in the right direction, we have devoted so much space to its discussion because Professor Ostwald's thoughts are suggestive and will not fail to provoke a discussion of the most important problem of science, which, in brief, is the question, "What is the philosophy of science?"

P. C.

HERMANN GRASSMANN'S GESAMMELTE MATHEMATISCHE UND PHYSIKALISCHE WERKE. I. Band. II. Theil. Die Ausdehnungslehre von 1862. Leipsic: B. G. Teubner. 1896. Pages, 511. Price, M. 16.

The task of publishing a complete edition of the mathematical and physical works of Hermann Grassmann was recently undertaken by the Royal Saxon Academy of Sciences, and the work of editing them has been entrusted to Friedrich Engel assisted by Jakob Lüroth, Eduard Study, Justus Grassmann, Hermann Grassmann, Jr., and Georg Scheffer. The first volume, which is now completed, embraces two parts: the first, the *Ausdehnungslehre* of 1844 (also containing the prize essay on geometrical analysis), has already appeared; the second, the *Ausdehnungslehre* of 1862, is that now in our hands. The relation of these two famous books will be better understood by a glance at Grassmann's life, which is interesting in more points than one, and whose contemplation is more apt to hold our attention than would be a difficult and abstract analysis of the contents of his works.

Hermann Grassmann, independent creator of a branch of mathematics which is accounted by some the most consummate piece of work in this direction that the present century has produced, was born (1809) and destined to spend his life in the German city of Stettin, commercially an important place and the central emporium of the German Baltic trade, but naturally bereft of the incentives and ideal environment which usually go to the formation of a scientific career. Grassmann, however, came of a talented family and one that remained talented. His two sons, Hermann Grassmann, now at Halle, and Justus Grassmann, at Brandenburg, have displayed unusual mathematical attainments.[1] His father also was a mathematical teacher of some note and had published a number of profound and original writings in which were contained the germs that determined the subsequent scientific bent of his son.

Hermann Grassmann first became a student of theology in Berlin and had among his teachers Neander and Schleiermacher, the latter of whom was not without influence upon his philosophical development. Now as afterwards his studies varied much, and even included the mathematical works of his father, but most of his work was done in philology. With interests comprehensive rather than vacillating we find him, shortly after taking his first theological examination, a teacher of mathematics in Berlin where he made the acquaintance of Jakob Steiner, whose epoch-making work on *Synthetic Geometry* had appeared two years previ-

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[1] Note the former's *Punktrechnung und projektive Geometrie*, the second part of which, *Grundlagen der projektiven Geometrie*, appeared last Easter in the programme of the Latin *Hauptschule*, of Halle.